PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XVIII, No. 11, pp. 261-265 APRIL 5, 1929

XI

THE GENERIC RELATIONSHIPS AND NOMENCLATURE OF THE CALIFORNIA SARDINE

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Confusion has long obtained and still prevails regarding the generic relationships and nomenclature of the California sardine. The earlier history involved is of no distinct pertinence to the present discussion, and will not now be recounted. We shall pick up the story with Regan's 1916 contribution.[1] In that paper, Regan referred the California sardine, as well as the related or identical species of Chile, Japan, Australia and South Africa, to the European genus *Sardina*.

Shortly thereafter, Jordan,[2] apparently on the advice of Seale, synonymized *Sardina* Antipa, 1906, with *Sardinia* Poey, 1858. He did so because Seale had located, in the collections of the Museum of Comparative Zoology, a specimen thought to be the type of Poey's species, *Sardinia pseudo-hispanica*, and showing the generic characters assigned by Regan to *Sardina*.

More recently, Thompson[3] pointed out a number of trenchant characters, more or less overlooked before, which

[1] Ann. and Mag. Nat. Hist., Ser. 8, 18, 1916, 11.

[2] Copeia, 56, 1918, 46 (*see also*, The Genera of Fishes, Stanford Univ. Publ., Univ. Ser., pt. 3, 1919, 299, and pt. 4, 1920, 512).

[3] Fish and Game Comm. Calif., Fish Bull., No. 11, 1926, 8-17.

serve to distinguish the sardines of California and Chile from those of Europe. The differences which he noted are as follows: (1) in the American species there is usually a row of dark blotches behind the head, typically not apparent in the European; (2) the scales, as Regan had already observed, are arranged in a very different and in a regular order, each alternate row not being nearly overlapped by the one in front (the apparent number of rows, therefore, is equal to, instead of being about half as numerous as, the true number); (3) the ventral scutes are weaker and less keeled, and have less expanded bases; (4) the gillrakers on the lower limb, unlike those of the European sardine, become gradually and markedly shortened toward the angle of the arch, and they differ markedly in number at comparable sizes; (5) the interopercle is more expanded and widely exposed behind the preopercle; and (6) the opercular ridges (and preopercular edge) are strongly oblique instead of being nearly vertical. All of these points I have completely verified. Other differences, pointed out by Thompson, involving the proportionate sizes of the parts or the position of the fins, appear less trenchant and need not be now considered.

One point not specified by Thompson, nor by Regan, is that the gillrakers of the upper limb fold down over those of the lower limb near the angle, whereas they do not do so in the European species. This very character Regan[4] elsewhere used in the primary separation of the genera of one division of the family.

Another difference in gillraker structure, equally trenchant, has just been discovered by Dr. Henry B. Bigelow, who has kindly allowed me permission to announce the interesting discovery. In the European sardines *(pilchardus* and *sardina)* we find that the minute processes on the gillrakers are simple, slightly-bent, sharply pointed spines, about one-third as long as the width of the gillrakers and spaced about three in a distance equal to this width. In the Californian species, and I find this equally true of the Chilean, Japanese and Australian forms, these processes are complex, for they are composed of a flask-shaped base or stalk and a distinct, fimbriate, grooved, leaf-like terminal element. The processes are nearly half,

[4]Ann. and Mag. Nat. Hist., Ser. 8, 19, 1917, 297-298.

sometimes more than half, as long as the gillrakers are wide, and are more crowded, as about five occur in a space equal to this width. The appearance of the gillrakers of Californian and European sardines, under a microscope, is strikingly unlike. The complex structure and greater length and crowding of these gillraker processes, as well as the longer and more numerous gillrakers, and their overfolding in the Californian and related sardines, provide a straining apparatus much finer than that possessed by the European species. This may perhaps be correlated with their living in seas in which diatoms are relatively more abundant, and crustaceans scarcer, than in European waters.

Even without recourse to the "splitting" tendencies of the day, it appears necessary to divorce generically the Californian and European sardines. Their differences, particularly in scale arrangement and in gillraker structure, are too fundamental and too trenchant to permit of their continued allocation in a single genus. The question of their immediate common origin is even thrown open to some doubt.

The generic separation of the Californian and European sardines reopens of course the problem of the proper generic name for each. It is necessary first to consider Poey's *Sardinia pseudo-hispanica*. The specimen so labelled in the Museum of Comparative Zoology, and stated to be Poey's type in Jordan's note, I have fortunately been able to reexamine. It certainly is not the type, for it is decidedly smaller than the one specimen described by Poey. Furthermore, it is not even conspecific, for it has 51 vertebræ, including the hypural, whereas Poey gives 46 as the number for *pseudo-hispanica*. In other respects, for instance, the lower number of dorsal rays, this alleged type fails to meet Poey's description. The specimen is probably a mislabelled example of the California sardine; at least it belongs to the same genus, for it agrees with it in every one of the characters listed above as distinguishing the Californian from the European species. A main reason for thinking that the specimen in question did not even come from Cuba is that there appears to be no other indication whatever of the occurrence of a sardine of either the Californian or the European type anywhere in the western Atlantic.

It is clear from Poey's description that his *Sardinia pseudo-hispanica* is not closely related to either the Californian or European sardine. There is very good reason to believe that he had the common West Indian species, *Sardinella anchovia* Cuvier & Valenciennes, 1847, which in turn is thought by Regan[5] to be identical with the European *Sardinella aurita* Cuvier & Valenciennes, the type-species of *Sardinella*. We find, for instance, that the number of vertebræ in *anchovia* is 46, just as in Poey's type of *pseudo-hispanica*. Jordan and Evermann's[6] *Clupanodon pseudohispanicus* is apparently the same species as their *Sardinella anchovia*.

It is therefore impossible to refer either the Californian or the European sardine to the genus *Sardinia* Poey, 1858. That name should, I think, be synonymized with *Sardinella* Cuvier & Valenciennes, 1847.

The generic name *Sardina* Antipa, 1906, therefore becomes available for the European species, which with Regan we may call *Sardina pilchardus* (Walbaum). No generic name, however, appears to be available for the California sardine. I now supply this obvious need:

Sardinops Hubbs, new genus

Type-species, *Maletta cærulea* Girard, 1854.

Diagnosis. Clupeidæ with the upper jaw not notably notched on the mid-line; the gillrakers of the upper limb folded over those of the lower limb, which become markedly and progressively shortened toward the angle; carina of glossohyal not denticulate;[7] no bilobed dermal flap on shoulder-girdle; opercle with strong and markedly oblique ridges; preopercular edge strongly sloping; interopercle widely exposed behind preopercle; scale-rows regularly spaced, the lateral scales all with subequal exposed areas; radii on the scales nearly vertical, and paired on each side of median line; keels on ventral scutes weak; last two rays of dorsal and anal fins somewhat enlarged; a row of dark spots typically developed on upper sides behind head.

[5] Ann. and Mag. Nat. Hist., Ser. 8, 19, 1917, 378.
[6] Bull. U. S. Nat. Mus., 47, pt. 1, 1896, 423 and 429.
[7] See Chabanaud, Bull. Soc. Zool. Fr., 51, 1926, 156-163.

Examples of the pilchards or sardines of Chile, Japan and Australia all agree fully with this generic diagnosis, and are clearly congeneric with *Sardinops cærulea* (Girard), as probably is also the South African species *ocellata,* which is known to share most of the characters listed above in common with *cærulea.* It is, in fact, not clear whether the species of these various regions are different from one another. Pending a much needed critical comparison of good material from all these localities, I merely list the species as usually recognized:

1. *Sardinops cærulea* (Girard), 1854. Californian.
2. *Sardinops sagax* (Jenyns), 1842. Chilean.
3. *Sardinops melanosticta* (Temminck & Schlegel), 1846. Japanese.
4. *Sardinops neopilchardus* (Steindachner), 1879. Australian.
5. *Sardinops ocellata* (Pappé), 1853. South African.

The distinctness of *Sardinops cærulea* is particularly doubtful, especially since Thompson *(l. c.)* was unable to differentiate it specifically from *S. sagax.*